



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/33

Paper 3 (Extended)

October/November 2010

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 16.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **14** printed pages and **2** blank pages.



- 1 The diagrams below show the electron arrangement in two compounds.

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Use



- (a) In a water molecule, each hydrogen atom is bonded to the oxygen atom by sharing a pair of electrons.

Why does an oxygen atom share two pairs of electrons rather than just one pair?

.....
..... [1]

- (b) Describe how a potassium atom becomes a potassium ion.

..... [1]

- (c) Why is there a bond between the ions in potassium chloride?

.....
..... [1]

- (d) Solid potassium chloride is a poor conductor of electricity. When dissolved in water it is a good conductor. Explain.

.....
..... [2]

[Total: 5]

2 Vanadium is a transition element.

(a) An atom of the most common isotope of vanadium can be represented as ${}_{23}^{51}\text{V}$.

Complete the following table to show the number of protons, electrons and neutrons in each particle.

particle	number of protons	number of electrons	number of neutrons
${}_{23}^{51}\text{V}$			
${}_{23}^{51}\text{V}^{3+}$			
${}_{23}^{50}\text{V}$			

[3]

(b) The major use of vanadium is to make vanadium steel alloys.

(i) Explain the phrase *steel alloys*.

.....
 [2]

(ii) State the name and use of another steel alloy.

name

use [2]

(c) Two of the oxidation states of vanadium are +3 and +4.

(i) Write the formula of vanadium(III) oxide and of vanadium(IV) oxide.

vanadium(III) oxide

vanadium(IV) oxide [2]

(ii) Vanadium(III) oxide is basic and vanadium(IV) oxide is amphoteric.
 Describe how you would obtain a sample of vanadium(III) oxide from a mixture of these two oxides.

.....

 [3]

[Total: 12]

3 The reactions of a metal and the thermal stability of some of its compounds are determined by the position of the metal in the reactivity series.

(a) To find the order of reactivity of the metals, cobalt, magnesium, silver and tin, the following experiments were carried out.

experiment	result
tin plus silver(I) nitrate solution	silvery layer on tin
magnesium plus tin(II) nitrate solution	grey deposit on magnesium
tin plus cobalt nitrate solution	no reaction

(i) Give as far as possible the order of reactivity of these metals.
Write the least reactive first.

..... [2]

(ii) What additional experiment needs to be done to put all four metals in order of reactivity?

..... [1]

(iii) Write an ionic equation for the reaction between tin atoms and silver(I) ions. Indicate on the equation the change which is oxidation.

.....
..... [3]

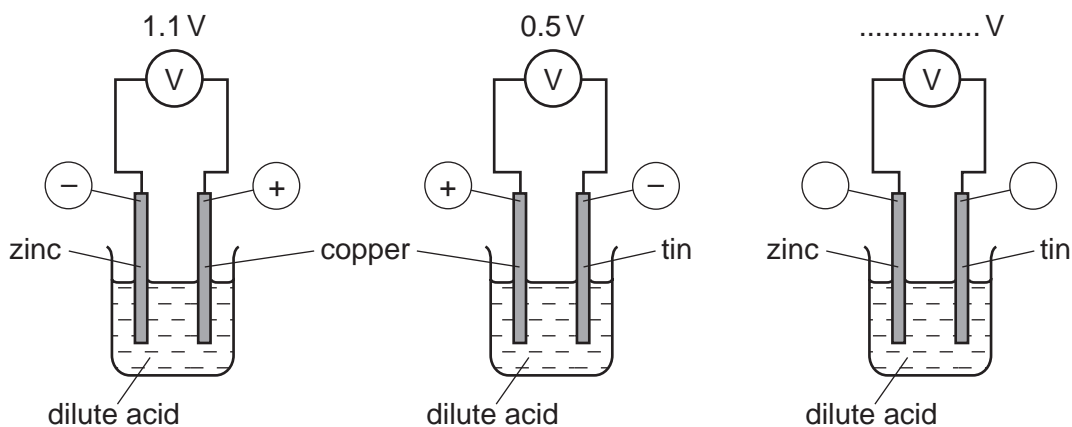
(b) Sodium is a more reactive metal than magnesium. Sodium compounds are more stable than magnesium compounds.

In an experiment, their hydroxides were heated. If the hydroxide did not decompose write 'no reaction' otherwise complete the equation.

$\text{NaOH} \rightarrow$

$\text{Mg(OH)}_2 \rightarrow$ [2]

(c) A cell consists of two different metal electrodes in an electrolyte. Three possible cells are shown below.



(i) Why is the more reactive metal the negative electrode?

.....
 [2]

(ii) How can you deduce that zinc is more reactive than tin?

..... [1]

(iii) How could you change the zinc/copper cell to have a voltage greater than 1.1 V?

..... [1]

(iv) Complete the labelling of the zinc/tin cell.

[2]

[Total: 14]

- 4 The electrolysis of concentrated aqueous sodium chloride, between inert electrodes, is used to make four important chemicals.

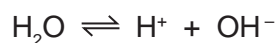
hydrogen
chlorine
sodium hydroxide
sodium chlorate(I)

- (a) The ions present in the electrolyte are Na^+ , H^+ , Cl^- and OH^- .

- (i) Hydrogen ions are discharged at the negative electrode (cathode).
Write an equation for this reaction.

..... [2]

- (ii) The hydrogen ions are from the water.



Suggest an explanation why the concentration of hydroxide ions increases.

.....
..... [2]

- (iii) When a dilute solution of sodium chloride is used, chlorine is not formed at the positive electrode (anode), a different gas is produced. Name this gas.

..... [1]

- (iv) State an example of an inert electrode.

..... [1]

- (b) (i) State a use of hydrogen.

..... [1]

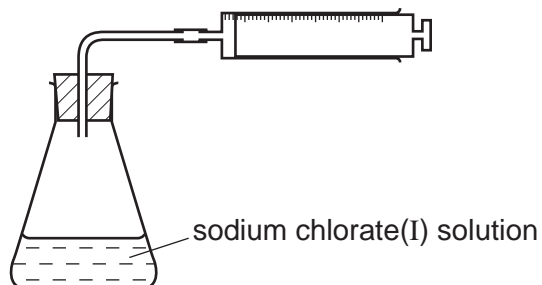
- (ii) Why is chlorine used to treat the water supply?

..... [1]

- (c) Sodium chlorate(I) is made by the reaction between chlorine and sodium hydroxide. It is used as bleach but over time it decomposes.



The rate of decomposition can be studied using the apparatus shown below.



- (i) How could you measure the rate of decomposition of sodium chlorate(I)?

..... [1]

- (ii) Describe how you could show that the rate of decomposition of sodium chlorate(I) is a photochemical reaction.

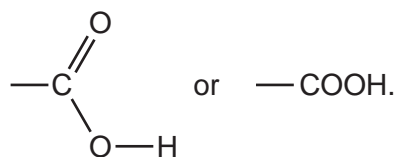
.....

..... [2]

[Total: 11]

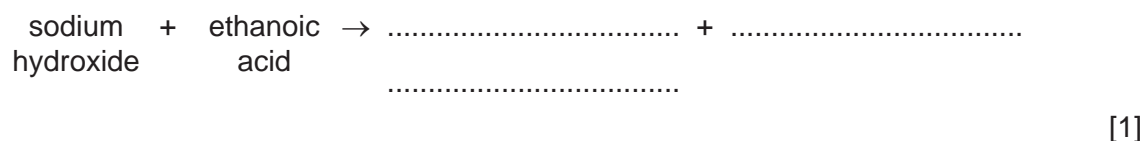
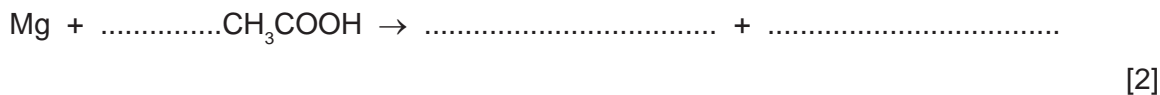
5 Carboxylic acids contain the group

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(a) Ethanoic acid is a typical carboxylic acid. It forms ethanoates.

(i) Complete the following equations.



(ii) Ethanoic acid reacts with ethanol to form an ester. Give the name of the ester and draw its structural formula. Show all of the bonds.

name

structural formula

[2]

(b) Maleic acid is an unsaturated acid. 5.8 g of this acid contained 2.4 g of carbon, 0.2 g of hydrogen and 3.2 g of oxygen.

(i) How do you know that the acid contained only carbon, hydrogen and oxygen?

.....

..... [1]

(ii) Calculate the empirical formula of maleic acid.

Number of moles of carbon atoms =

Number of moles of hydrogen atoms =

Number of moles of oxygen atoms =

The empirical formula is [3]

9

(iii) The mass of one mole of maleic acid is 116 g. What is its molecular formula?

..... [2]

(iv) Maleic acid is dibasic. One mole of acid produces two moles of H^+ . Deduce its structural formula.

[2]

[Total: 13]

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6 The Kinetic Theory explains the properties of matter in terms of the arrangement and movement of particles.

(a) Nitrogen is a gas at room temperature. Nitrogen molecules, N_2 , which are spread far apart move in a random manner at high speed.

(i) Draw a diagram showing the arrangement of the valency electrons in a nitrogen molecule.

Use \times to represent an electron from a nitrogen atom.

[2]

(ii) How does the movement and arrangement of the molecules in a crystal of nitrogen differ from those in gaseous nitrogen?

.....
.....
..... [3]

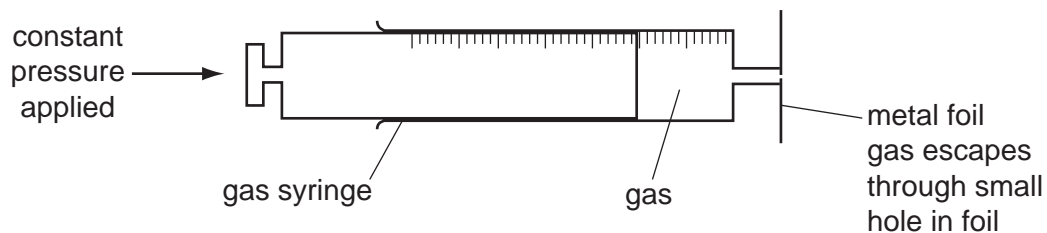
(b) Use the ideas of the Kinetic Theory to explain the following.

(i) A sealed container contains nitrogen gas. The pressure of a gas is due to the molecules of the gas hitting the walls of the container.

Explain why the pressure inside the container increases when the temperature is increased.

.....
..... [2]

(ii) The following apparatus can be used to measure the rate of diffusion of a gas.



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The following results were obtained.

gas	temperature /°C	rate of diffusion in cm ³ /min
nitrogen	25	1.00
chlorine	25	0.63
nitrogen	50	1.05

Explain why nitrogen diffuses faster than chlorine.

.....
 [2]

Explain why the nitrogen diffuses faster at the higher temperature.

..... [1]

[Total: 10]

7 Synthetic polymers are widely used in the modern world.

(a) Their use has brought considerable advantages to modern life as well as some disadvantages.

(i) Suggest **two** advantages of a plastic bucket compared to a steel bucket.

.....
..... [2]

(ii) Name **two** uses of man-made fibres, such as nylon and Terylene.

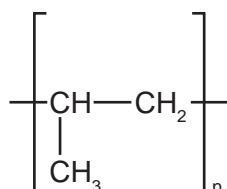
.....
..... [2]

(iii) Describe the pollution caused by synthetic polymers.

.....
.....
..... [3]

(b) One type of polymer is formed by addition polymerisation.

(i) The structural formula of an addition polymer is given below.



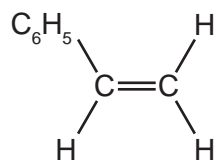
Give the name and structural formula of the monomer.

name of monomer [1]

structural formula of monomer

[1]

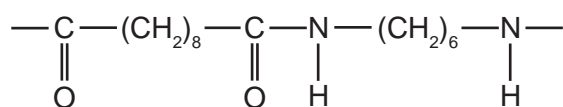
- (ii) Draw the structural formula of the addition polymer formed by the polymerisation of phenylethene. The structural formula of phenylethene is given below.



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Use

[2]

- (c) Nylon is made by condensation polymerisation. It has the structural formula shown below.



- (i) Name the linkage in this polymer.

..... [1]

- (ii) Name the natural macromolecules which have the same linkage.

..... [1]

- (iii) Deduce the formulae of the two monomers which reacted to form the nylon and water.

monomer

monomer

[2]

[Total: 15]

DATA SHEET
The Periodic Table of the Elements

I		Group										VII	VIII																														
		II	III	IV	V	VI																																					
7 Li Lithium 3		1 H Hydrogen 1										19 F Fluorine 9		2 He Helium 2																													
9 Be Beryllium 4		11 B Boron 5										16 O Oxygen 8		10 Ne Neon 10																													
23 Na Sodium 11		13 Al Aluminium 13										14 C Carbon 6		17 Cl Chlorine 17		18 Ar Argon 18																											
24 Mg Magnesium 12		25 Mn Manganese 25										27 Fe Iron 26		28 Co Cobalt 27		30 Zn Zinc 30		31 Ga Gallium 31		32 Ge Germanium 32		33 As Arsenic 33		34 Se Selenium 34		35 Br Bromine 35		36 Kr Krypton 36															
39 K Potassium 19		40 Ca Calcium 20										41 V Vanadium 23		42 Cr Chromium 24		43 Mn Manganese 25		44 Fe Iron 26		45 Co Cobalt 27		46 Ni Nickel 28		47 Cu Copper 29		48 Zn Zinc 30		49 Ga Gallium 31		50 Ge Germanium 32		51 As Arsenic 33		52 Se Selenium 34		53 Br Bromine 35		54 Kr Krypton 36					
85 Rb Rubidium 37		88 Sr Strontium 38										89 Y Yttrium 39		90 Zr Zirconium 40		91 Nb Niobium 41		92 Mo Molybdenum 42		93 Tc Technetium 43		94 Ru Ruthenium 44		95 Rh Rhodium 45		96 Pd Palladium 46		97 Ag Silver 47		98 Cd Cadmium 48		99 In Indium 49		100 Sn Tin 50		101 Sb Antimony 51		102 Te Tellurium 52		103 I Iodine 53		104 Xe Xenon 54	
133 Cs Caesium 55		137 Ba Barium 56										138 La Lanthanum 57		139 Ce Cerium 58		140 Pr Praseodymium 59		141 Nd Neodymium 60		142 Pm Promethium 61		143 Sm Samarium 62		144 Eu Europium 63		145 Gd Gadolinium 64		146 Tb Terbium 65		147 Dy Dysprosium 66		148 Ho Holmium 67		149 Er Erbium 68		150 Tm Thulium 69		151 Yb Ytterbium 70		152 Lu Lutetium 71			
226 Fr Francium 87		227 Ra Radium 88										228 Ac Actinium 89		229 Th Thorium 90		230 Pa Protactinium 91		231 U Uranium 92		232 Np Neptunium 93		233 Pu Plutonium 94		234 Am Americium 95		235 Cm Curium 96		236 Bk Berkelium 97		237 Cf Californium 98		238 Es Einsteinium 99		239 Fm Fermium 100		240 Md Mendelevium 101		241 No Nobelium 102		242 Lr Lawrencium 103			
226 Ra Radium 88		227 Ac Actinium 89										228 Th Thorium 90		229 Pa Protactinium 91		230 U Uranium 92		231 Np Neptunium 93		232 Pu Plutonium 94		233 Am Americium 95		234 Cm Curium 96		235 Bk Berkelium 97		236 Cf Californium 98		237 Es Einsteinium 99		238 Fm Fermium 100		239 Md Mendelevium 101		240 No Nobelium 102		241 Lr Lawrencium 103					

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

*58-71 Lanthanoid series
†90-103 Actinoid series

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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